Irrigation in Alberta

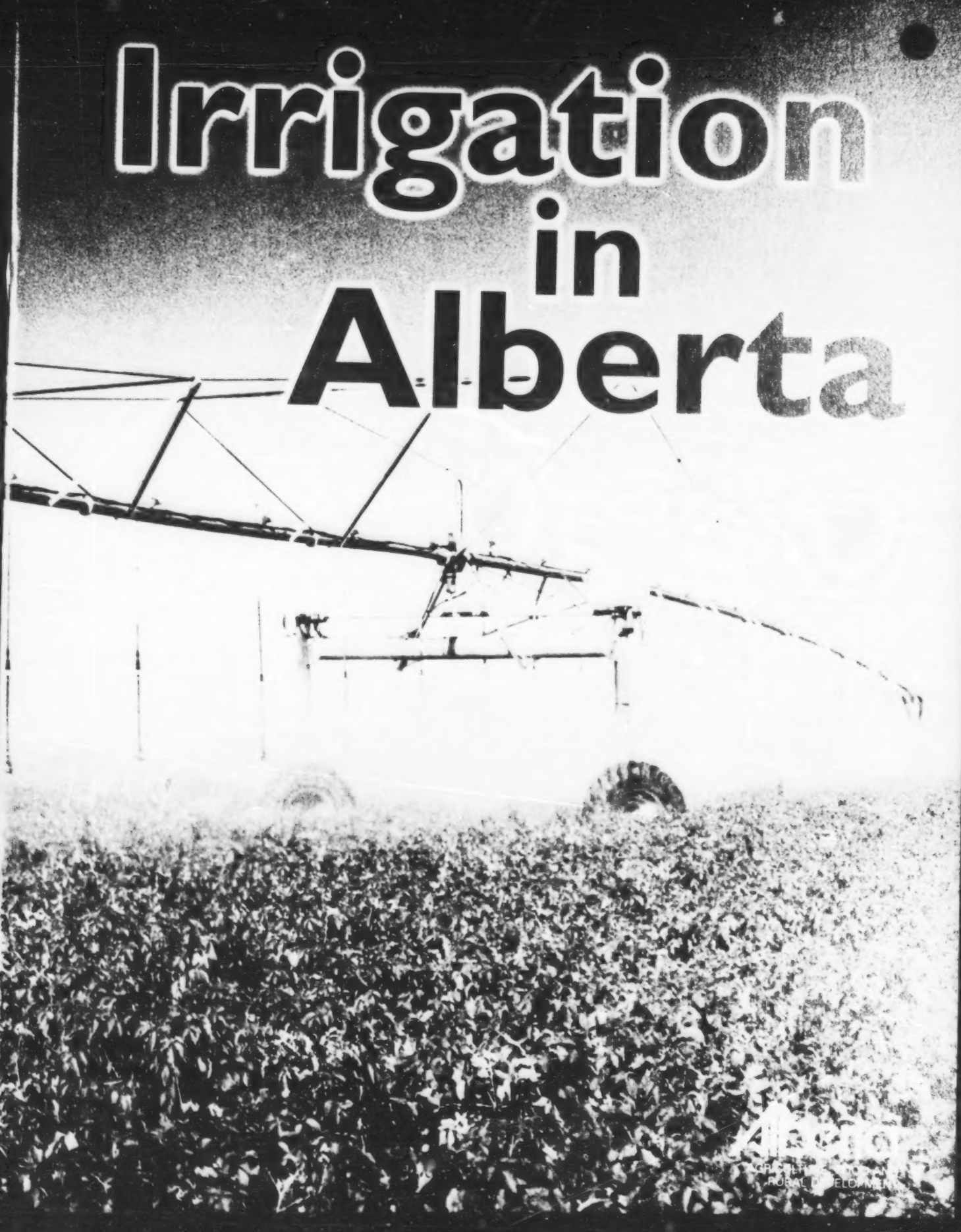

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Photo on page 8 - Kirt Wolf, United
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Metric Conversions

1 kilometre (km) = 0.62 miles
1 metre = 3.28 feet
1 centimetre (cm) = 0.39 inches
1 millimetre (mm) = 0.039 inches
1 hectare = 2.471 acres
1 cubic decametre = 0.81 acre feet

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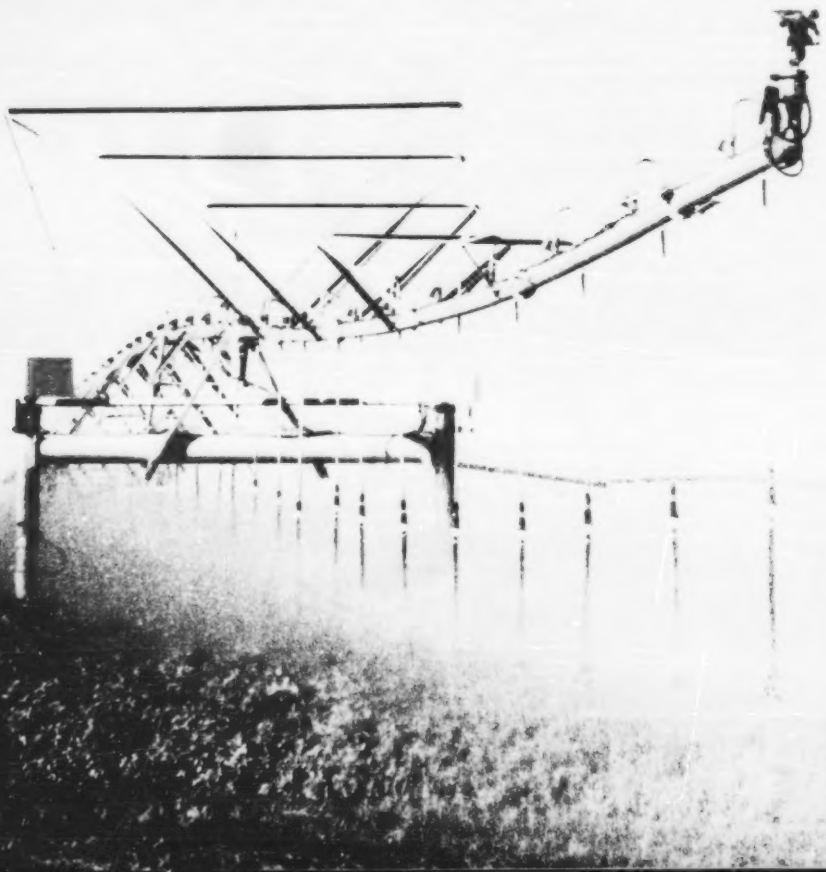

Irrigation in Alberta

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A modern pivot irrigation system irrigates a field of canola.

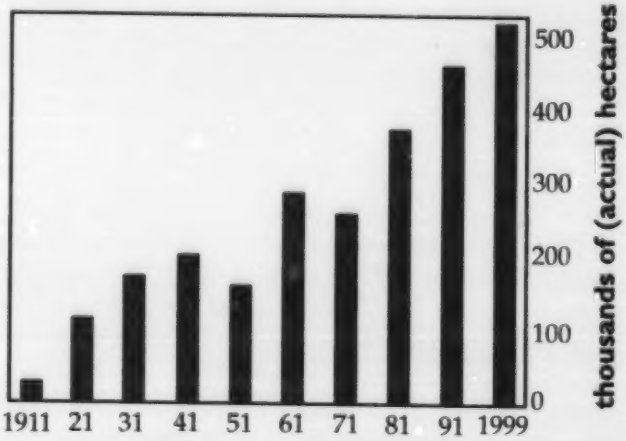
The benefits of irrigation

More than a century ago, water for Alberta's first irrigation project was diverted from Fish Creek, near Calgary. Now, at the beginning of the 21st century, about 600,000 productive hectares of land, mostly within the 13 irrigation districts in the southern part of the province, are receiving water through irrigation. Millions of litres of irrigation water are also being used to support the growth of Alberta's livestock and food processing industries. Directly and indirectly, irrigation adds about 35,000 jobs and more than $940 million dollars a year to the provincial economy. Alberta irrigation helps keep a regular supply of low cost, high quality food on tables in Canada and throughout the world. The province's expertise in irrigation technology and research is also helping increase world food supplies in countries like Egypt, Pakistan, India and China.

Agronomic and economic benefits aren't the only impacts of irrigation. The province's irrigation reservoirs are a recreational destination for both Albertans and visitors to the province. Reservoirs and canals provide critical habitat for birds, mammals, fish and other wildlife on the dry prairies. Irrigation is also used to supply domestic, municipal and industrial water to many small communities and farmsteads in the province. The assurance of a good quality water supply has helped stabilize these farms and communities, and in turn, has led to improved economic and social conditions for rural people.

In recent years, the development and operation of irrigation systems is focusing more on environmental concerns. Increased demands on limited water resources are challenging further development and encouraging agricultural producers, industry and government to make more efficient use of the water supply and the irrigation systems already in place. The goal in the next decades will be to further improve the irrigation infrastructure and water use efficiency, while safeguarding the environment. Already, rehabilitation of the irrigation infrastructure and use of advanced on-farm irrigation technology are conserving water and energy. Hydro-electric facilities are being installed on the irrigation infrastructure to reduce our dependence on fossil fuels for generating power. Food processing wastewater is being treated and used to irrigate crops. Research and development on more drought-resistant crop varieties will also save water.

This booklet briefly examines the past history and present status of irrigation in Alberta to help readers understand the contribution irrigation has made to Alberta society and the challenges facing the irrigation industry in the future.



growth of alberta's irrigation districts

Farmers at a demonstration of surface irrigation using gated pipe.

A legacy of cooperation

Irrigation in Alberta owes its existence to the foresight and optimism of 19th century government officials, the speculative zeal of Canada's early entrepreneurs, and the spirit and technical know-how of pioneering settlers.

The construction of the Canadian Pacific Railway in the late 1800s started a minor land boom on Canada's prairies, one the railway company and the federal government hoped to foster. Irrigation was seen as a key element in attempts to attract settlers. After a prolonged drought struck the area, and through the urging of Department of the Interior officials, William Pearce and J.S. Dennis, the federal government passed the Northwest Irrigation Act of 1894. Rather than leave water rights in the hands of property owners, the Act gave control of irrigation diversion and water use to the federal government.

All surface waters were declared the property of the Crown, and the rights to use the water could be obtained only through government license. Both the water resources and potential agricultural lands were surveyed, to see which areas would benefit most from irrigation and where irrigation was most practical or feasible.

In Alberta, however, small-scale irrigation works were already being built. Mormon settlers, in particular, were putting the experiences and technical skills learned in their former Utah homeland to work, creating effective irrigation systems in the dry southern part of the province. Work was completed on the first successful, large-scale irrigation project in 1900. This system — 184 kilometres of canal southwest of Lethbridge — opened thousands of hectares of land to colonization.

In 1903, the Canadian Pacific Railway began construction of a diversion weir on the Bow River near Calgary and a system of canals to bring water to 80,000 hectares of farmland, called the Western Block. It was hoped the irrigation project would increase shipping and passenger business and the sale of land acquired during the building of its transcontinental rail line. Six years later, the CPR started work on an even larger project, a diversion structure downstream on the Bow River, near Bassano, and a distribution and canal system to irrigate the Eastern Block, about 160,000 hectares near Brooks.

In the long run, these large commercial ventures were not financially successful. However, they laid the groundwork for a series of legislative enactments aimed at developing the irrigation potential of the province.

The Irrigation Districts Act

In 1914, the government of Alberta passed the Irrigation Districts Act. The legislation allowed land owners to organize themselves into local cooperatives, which could then issue bonds for the construction of large-scale irrigation projects. The federal and provincial governments would help with construction of the headworks. Government guarantees were established to help farmers mortgage their land to provide funds for the work done by the districts. The districts were also given the authority to levy local taxes for the operation and maintenance of the irrigation projects and to deal with the day-to-day administration of the systems.

The concept of farmer-owned and operated irrigation districts, unique to Alberta, was a natural outgrowth of the

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government's commitment to the development of agriculture and to the farmers' willingness to work together for mutual benefits. In all, 13 irrigation districts were formed in subsequent years, with capitalization and operating expenses shared by the provincial and federal governments as well as the districts themselves. In 1919, more than 7,500 hectares of district land were in irrigated production.

Greater government support

Though irrigation continued to grow as both an economic and a social force, returns on investments during the 1920s were not as high as anticipated. To keep the industry growing, and because it was felt benefits would accrue to society as a whole, the provincial and federal governments agreed to fund all major capital works. They also helped pay some of the debts which had been incurred by the farmer cooperatives and private corporations in building the existing infrastructure.

The governments also encouraged the planting of higher-value crops and promoted better farming practices, initiating technical assistance and education programs. Soil surveys were undertaken and information on climate and other geographic factors was gathered, starting a data bank that is stili being referenced and expanded today.

In 1931, following the transfer of natural resources jurisdiction from the federal government to the provinces, Alberta passed its first Water Resources Act, solidifying the province's support of the irrigation districts. The creation of the Prairie Farm Rehabilitation Administration (PFRA) in 1935, as an agency of Agriculture and Agri-food Canada, initiated an era of increased federal government involvement in irrigation. Through the PFRA, the federal government became a major developer of new storage and delivery systems, including the St. Mary, Milk River Ridge and Waterton reservoirs, as well as the associated diversion canals. By 1950, the irrigation districts serviced more than 182,000 hectares of farm land.

A new provincial irrigation act was passed in 1968, and a year later, water apportionment was revised under a reconstituted Prairie Provinces Water Board. This cooperative government effort allocated about one third of the prairie's total surface water resources for consumptive use in Alberta, with the remaining water mandated for downstream flows.

Though basic maintenance on the infrastructure had been looked after by the irrigation districts, it became apparent after World War II that a major rehabilitation and expansion program was needed. In 1950, in cooperation with the PFRA, the province began rebuilding and enlarging the main delivery system in the Bow River Irrigation District, as well as in the St. Mary River Irrigation District from Taber to Medicine Hat. This work was continued under the Alberta Irrigation Capital Works Program and broadened to include the other irrigation districts.

By the beginning of the 1970s, the federal government felt it had achieved its goal of stabilizing irrigation in Alberta and transferred most of its interests to the province. The province thus assumed even greater responsibility for rehabilitation and expansion of the distribution infrastructure. As part of a cost-sharing program with the irrigation districts, the Alberta government paid 86% of construction expenses and provided engineering and agrological services. In 1976, with the initiation of the Alberta Heritage Trust Fund, more money was allocated for irrigation capital works. (In 1995, the cost-sharing formula was changed. The provincial government now pays 75% of rehabilitation costs, and the irrigation districts pay 25%.)

IRRIGATION DISTRICT (I.D.)		
	1917	1917
	1919	1923
	1921	1923
	1923	1931
	1925*	1900
	1926*	1900
	1935*	1914
	1936	1944
	1946*	1907
	1948	1959
	1949	1954
	1965*	1900
	1968*	1920

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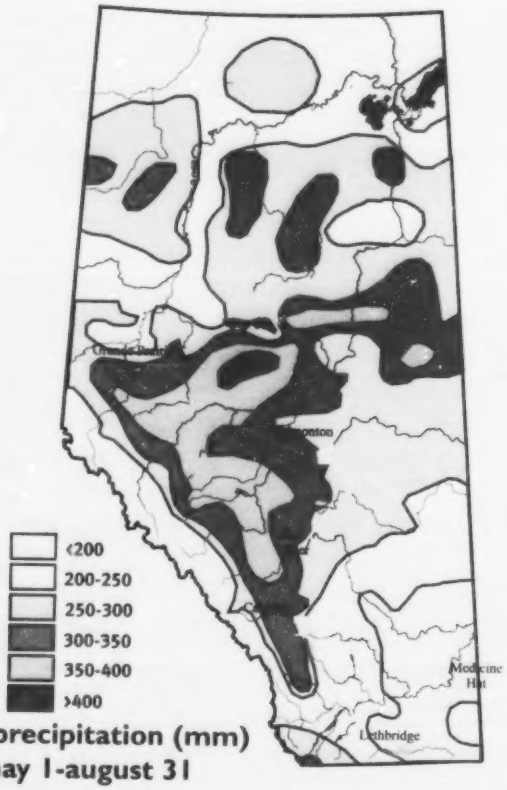
IRRIGATION DISTRICT (I.D.)	Year I.D. Formed	First Water Drawn
Taber I.D.	1917	1917
Lethbridge Northern I.D.	1919	1923
United I.D.	1921	1923
Mountain View I.D.	1923	1931
Raymond I.D.	1925*	1900
Magrath I.D.	1926*	1900
Eastern I.D.	1935*	1914
Leavitt I.D.	1936	1944
Western I.D	1944*	1907
Aetna I.D.	1945	1959
Ross Creek I.D.	1949	1954
St. Mary River I.D.	1968*	1900
Bow River I.D.	1968*	1920

*formation of an irrigation district from existing irrigated areas

Alberta's irrigation system



total precipitation (mm)
may 1-august 31

Unlike the American Midwest, where irrigation depends so heavily on dwindling groundwater resources, Alberta's irrigation water comes from its rivers. Through a diverse irrigation infrastructure, spring precipitation and mountain snowmelt is rechannelled, stored and later put to use in the more arid parts of the province, where it's most needed.

Though Alberta has abundant water resources, precipitation is scarcest where the agricultural potential is greatest. The southern part of the province, with a growing season of about 150 days, receives only 300-450 mm of precipitation annually. Less than half falls from May through August, during the growing season.

The combination of abundant sunshine, warm temperatures and a long growing season results in an average net water deficit of 380 mm a year for crops grown in the southeast corner of the province. Though the deficit is less in other parts of southern Alberta, chinook winds reduce moisture retention. Irrigation allows water stored in the spring to be used in midsummer, to help balance these deficits. Limits on irrigation expansion were established in 1991, to offset concerns about scarce water supplies in the South Saskatchewan River Basin.

Alberta is unique in Canada in requiring land to be classified suitable for irrigation under sustained production. Standards for soil classification irrigability consider soil depth, parent material, texture, drainage, salinity, pH, erodibility and organic matter content. Topography, groundwater factors and natural vegetation are also considered before an irrigation water right is granted.

Most of the soils in southern Alberta are ideally suited to irrigation. The area's medium to fine-textured glacial tills have good water-holding capacities and slow movement through the lower root zone. The coarse-textured soils are also productive, though more difficult to manage due to a high water percolation rate and low water retention.

The Alberta Irrigation Districts Act, which came into effect in 2000, allows irrigators greater autonomy and independence, but with greater accountability. Under the Act, an irrigator can, with the consent of their irrigation district, change the point of diversion and the location of an irrigated field. He may also transfer a water right to a different piece of land, as long as it also is classified for irrigation.

Alberta Environment maintains the right to change or revoke a license if water resources are being negatively impacted. Interbasin transfers are not allowed, but the government can issue new licenses, provided the resource base has sufficient water.

The provincial government, through Alberta Environment and Alberta Agriculture, Food and Rural Development (AAFRD), also maintains partial responsibility for irrigation planning, research and infrastructure upgrading. In the year 2000, for example, approximately $47 million was allocated for infrastructure upgrades alone.

AAFRD's Irrigation Branch provides research, consultation, and extension services to the irrigation industry through its Farm Irrigation Management, Irrigation Development, and Resource Conservation sections. A team of specialists with

the Irrigation Branch offers technical assistance on crop water management, efficient use of water, equipment selection, and beneficial management practices. The Branch also monitors soil and water quality and maintains the land classification standards that encourage sustainable farm practices. Research on the environmental effects of irrigation is a critical part of its mandate.

The federal government maintains its involvement with infrastructure development and resource protection, particularly in regard to the protection of fisheries, and with respect to international and interprovincial water apportionment.

Irrigation in Alberta Today

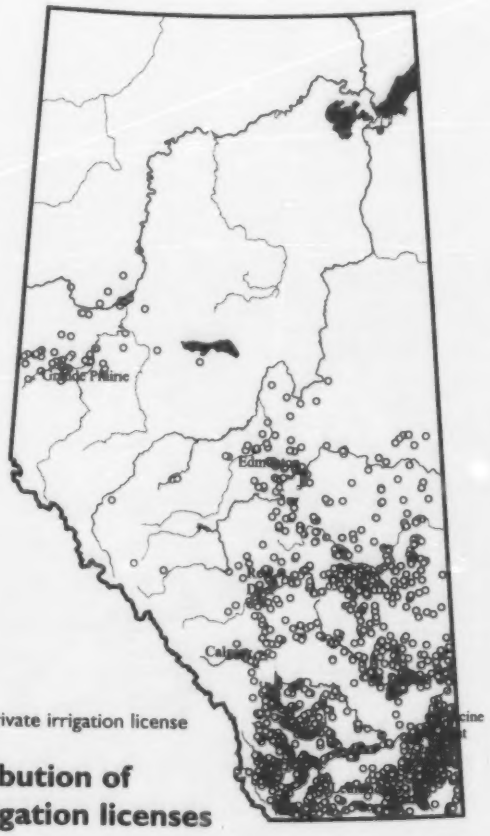
The greatest part of irrigation activity in Alberta takes place in the 13 irrigation districts in the South Saskatchewan River Basin. Approximately a half million hectares of land receive irrigation water through the operations of the districts, though the government continues to set the conditions under which they operate. The Alberta Irrigation Projects Association (AIPA) acts as an umbrella group for the districts, coordinating joint activities, such as education and research.

In addition, more than 2,700 private irrigation projects have authorization to use Alberta's water resources. These projects are totally funded, developed and operated by their licensees. They vary in size from two hectares to more than 10,000 hectares, and together total more than 112,000 hectares of land. Private irrigation projects are located as far north as the Athabasca and Peace Rivers, but the majority have been developed in southern Alberta.

The largest private license in the province is the Blood Tribe Agricultural Project, which obtains water from the Waterton, Belly and St. Mary rivers. The project irrigates more than 10,000 hectares on the Blood Reserve, largely for non-aboriginal leaseholders, and is a significant source of economic activity for the Blood Tribe.

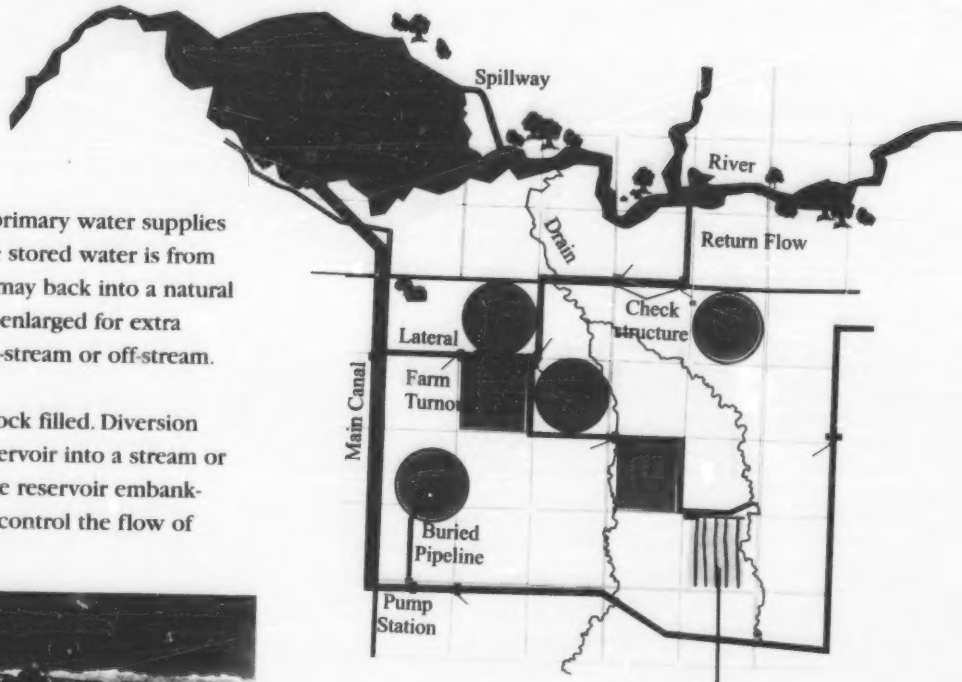
In all, irrigation licenses have been allocated for the withdrawal of more than 3.8 million cubic decametres of water. This figure, however, is less than the volume of irrigation water actually being used. The difference between water assessments and actual use, coupled with new water conveyance and application technologies and better farm management practices, could allow for an increase in irrigated land area. Based on current average consumptive use of water for southern Alberta's irrigated crops of 4.8 cubic decametres per hectare, estimates are that an additional 125,000 hectares could be irrigated, without increasing water allocations, and without environmental, economic or social concerns.

The Year 2000 Irrigation Water Allocation Review, a five-year cooperative study by the Irrigation Branch, the AIPA, and the PFRA, addressed the challenges of irrigation expansion and identified improvements in water management efficiencies that would allow such expansion to occur within the confines of current water allocations. In the Taber Irrigation District, for example, more than 90% of the delivery system rehabilitation has been completed. Similar improvements in water use efficiency continue to be made in other districts.



distribution of private irrigation licenses

Alberta's Irrigation Infrastructure



Reservoirs store and control primary water supplies for irrigation. In Alberta, most of the stored water is from spring snowmelt. The stored water may back into a natural coulee, valley or lake that is usually enlarged for extra capacity. Reservoirs may be built on-stream or off-stream.

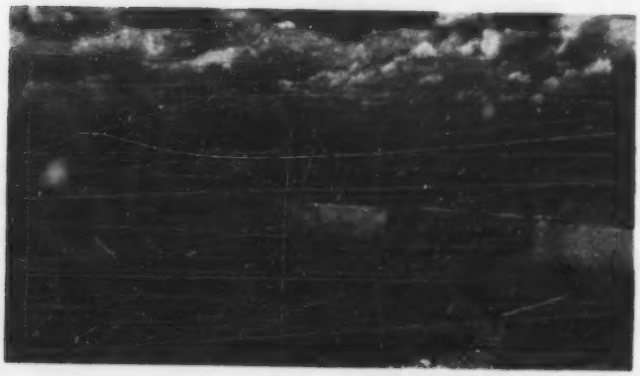
Dams in Alberta are earthen or rock filled. Diversion structures direct water from the reservoir into a stream or diversion canal. Spillways protect the reservoir embankments and irrigation structures and control the flow of flood waters.

Return flow channels carry excess irrigation water back to a river or reservoir. They can be natural drainage systems or man-made canals.

Border dykes make surface or flood irrigation more efficient. Water is supplied from a delivery ditch at the upper end of a graded field, using syphons or turnouts. Excess water is collected at the lower end of the field, then channelled to a return flow. The fields are usually levelled to follow a downslope of less than 2% to decrease erosion.

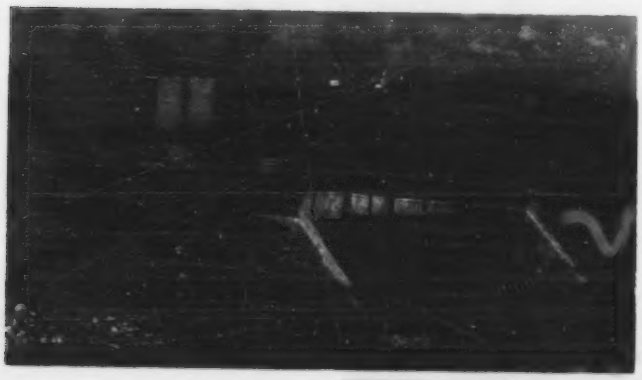
Drop structures placed at intervals along a channel stabilize it by changing its profile from a continuous steep gradient to a series of more gently sloping reaches.

Pipelines can be used to replace surface canals and to bring water from the canals to the farm pivots. They are usually located underground.



Check structures are built into canals to raise and hold water at a specific level and facilitate upstream delivery.

Turnouts are used to divert water from a canal or other supply source. Multi-piped turnouts with motorized and computer-controlled gates are used to divert larger amounts of water. On-farm turnouts may be only gated culverts.



Gates are used to open and close turnouts and other diversion structures. Trash screens are often used to keep gates from clogging.

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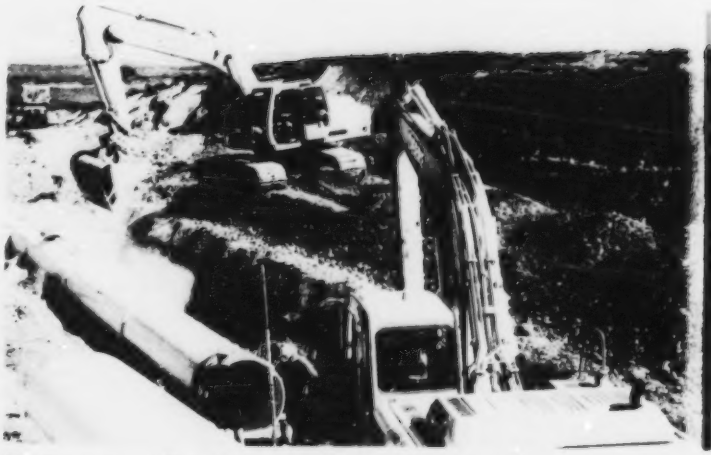
Getting water to the crops

Irrigation in Alberta is made possible through a complex infrastructure that diverts water from the province's streams and conveys it to the land. Water diverted from five major rivers and several smaller streams is stored in both on-stream and off-stream reservoirs, then conveyed to cultivated land and pastures through more than 7,500 kilometres of canals and pipelines.

In the St. Mary River Irrigation District (SMRID), for example, water is drawn from the Belly, Waterton and St. Mary rivers. Nine large and six small reservoirs store water for use during and beyond the crop-growing season. The water is distributed through a grid of main and lateral canals and pipelines to 115,000 hectares of crops and to supply many thousands of livestock animals. In addition, the works of the SMRID convey water to several municipalities and industrial operations. Water for the Magrath, Raymond and Taber Irrigation Districts is also drawn from the St. Mary headworks and conveyance system.

The Oldman Reservoir, with a capacity of almost 500,000 cubic decametres of water, is the largest in the system. In contrast, Cavan Lake Reservoir on Gros Ventre Creek has a capacity of only 1,900 cubic decametres and supplies water to 500 hectares of agricultural land in the Ross Creek Irrigation District near Medicine Hat.



Pipelines are rapidly replacing open irrigation canals in the irrigation districts.

Pine Coulee Reservoir, completed in 1989, has a capacity of more than 50,000 cubic decametres. It supplies water to 5,200 privately irrigated hectares and ensures a water supply for 1,500 area residents. The project features a diversion weir on Willow Creek which feeds water to an off-stream storage reservoir, reducing the potential for environmental impacts on the creek. During Willow Creek's low flow periods, water from Pine Coulee Reservoir can also be diverted back to supplement creek flows.

The new Little Bow Reservoir is designed to reduce water diversions to the Little Bow River from the Highwood River during summer low flow periods. The project ensures water supplies to existing privately irrigated land and makes irrigation available to an additional 8,000 hectares. It also secures municipal water supplies for the area's rural residents. A canal to Clear Lake from Mosquito Creek will stabilize water levels for a dozen nearby wetlands, improving recreational opportunities and wildlife habitat, while supporting private irrigation on another 1,500 hectares of agricultural land.

As has been noted, much of the system has undergone rehabilitation in the last few decades. Seepage has been almost eliminated through the lining of canals, and salinized and waterlogged lands have been reclaimed. Most of the irrigation districts have also initiated programs to replace open

ALBERTA'S IRRIGATION SYSTEM	Length of Distribution System	Hectares Under Irrigation (Assessed Hectares)
IRRIGATON DISTRICTS		
Aetna I.D.	27 km	781
Bow River I.D.	1,058 km	80,209
Eastern I.D.	1,784 km	111,267
Leavitt I.D.	56 km	1,862
Lethbridge Northern I.D.	650 km	49,326
Magrath I.D.	106 km	4,528
Mountain View I.D.	35 km	426
Raymond I.D.	247 km	13,053
Ross Creek I.D.	20 km	427
St. Mary River I.D.	1,719 km	138,712
Taber I.D.	364 km	31,110
United I.D.	227 km	6,992
Western I.D.	1,077 km	27,373
PRIVATE LICENSES:	—	112,435
TOTAL LAND ASSESSED FOR IRRIGATION: 578,705 HECTARES		

Getting water to the crops

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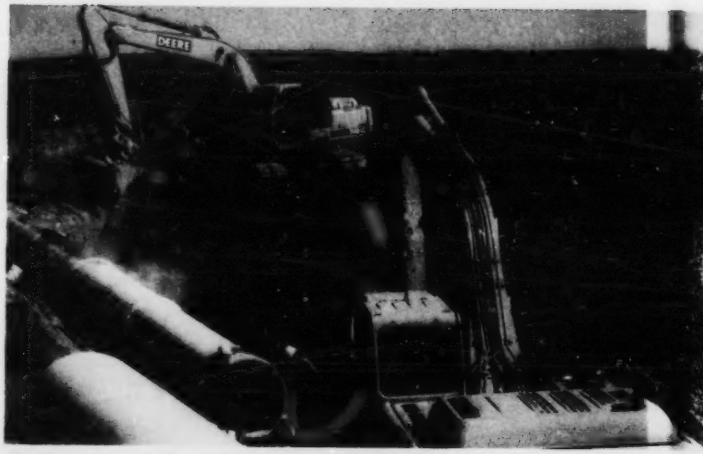


Pipelines are rapidly replacing open irrigation canals in the irrigation districts.

Pine Coulee Reservoir, completed in 1999, has a capacity of more than 50,000 cubic decametres. It supplies water to 5,200 privately irrigated hectares and ensures a water supply for 4,500 area residents. The project features a diversion weir on Willow Creek which feeds water to an off-stream storage reservoir, reducing the potential for environmental impacts on the creek. During Willow Creek's low-flow periods, water from Pine Coulee Reservoir can also be diverted back to supplement creek flows.

The new Little Bow Reservoir is designed to reduce water diversions to the Little Bow River from the Highwood River during summer low-flow periods. The project ensures water supplies to existing privately irrigated land and makes irrigation available to an additional 8,000 hectares. It also secures municipal water supplies for the area's rural residents. A canal to Clear Lake from Mosquito Creek will stabilize water levels for a dozen nearby wetlands, improving recreational opportunities and wildlife habitat, while supporting private irrigation on another 1,500 hectares of agricultural land.

As has been noted, much of the system has undergone rehabilitation in the last few decades. Seepage has been almost eliminated through the lining of canals, and salinized and waterlogged lands have been reclaimed. Most of the irrigation districts have also initiated programs to replace open

ALBERTA'S IRRIGATION SYSTEM

	781
	80,209
	111,267
	1,862
	49,526
	4,528
	426
	13,055
	427
	138,712
	31,110
	6,992
	27,375

TOTAL LAND ASSESSED FOR IRRIGATION: 578,705 HECTARES

ditches with pipelines, reducing evaporation and seepage losses. Installation of underground pipelines allows the districts to expand their irrigated areas without using more water. Pipelines also make the water less susceptible to contamination, need less maintenance, and provide better water control. The water savings, reduced maintenance and opportunity to irrigate more land offsets the high capital investment of the work.

Canal bank slope and bed width designs have been standardized to lower maintenance costs and move water more effectively. Canals have also been aligned to facilitate more effective farm practices.

On-Farm Irrigation Systems

Improvements in on-farm irrigation equipment and management techniques in the last three decades have also led to increases in the irrigated land base and more sustainable agricultural practices. Water use efficiency — the ratio of the amount of water applied and retained within the active root zone to the total amount of water delivered into the on-farm irrigation system — has increased substantially.

The right choice of an on-farm water application system for a particular producer is based on topography, soil, the type of crops being grown, and the capital and labour available. Generally, surface or gravity flow irrigation is the least expensive to develop, averaging an investment of $750 to $900 per hectare. However, surface irrigation is more labour intensive to operate, has only low to moderate water application efficiencies, and may be more damaging to soils. Flooding a field can lead to salt build-up and the creation of waterlogged areas. It is also difficult to control the amount of water each part of a field receives when flooded. Thus, crops may be over or under-irrigated, reducing yields and sustainability. Surface irrigation is most efficient on levelled land, where slopes are moderate and controlled.

An average centre-pivot sprinkler installation costs about $1500-$1800 per hectare, but such sprinkler systems are far more water efficient and convenient. The amount of land under irrigation has more than doubled since their adoption. Surface irrigation, which remained the most common irrigation practice until about 1950, now accounts for less than 16% of all on-farm irrigation in Alberta. Fewer than 30% of irrigated farms use lateral-move or side-roll sprinkler systems and more than half now use centre pivot sprinkler systems.

Surge valves can reduce erosion, improve the overall efficiency of surface irrigation and substantially reduce the amount of water needed for optimal fields.

Surface irrigation

Surface irrigation uses gravity to get water from the canals to the crops. In early gravity-fed systems, the entire field was flooded, with water coming from a supply ditch, pipeline, or other source. In some cases, crops were planted in deeply furrowed rows and water was directed into the furrows.

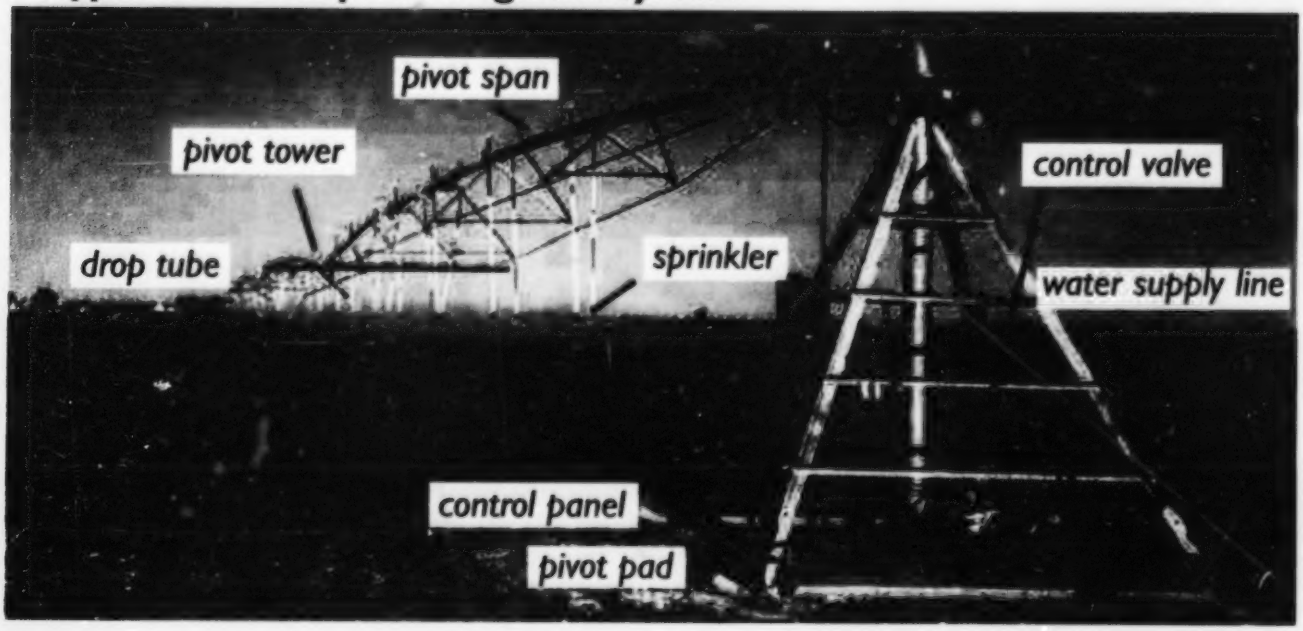
More modern approaches use gated pipe, surge valves and siphon tubes to reduce water use and runoff. Excess run-off water is channelled into tailwater dugouts, where it is pumped back to the field for re-use. The use of border dykes or levees to contain and control the flow of the water on the fields has greatly improved application efficiencies.

Surface irrigation is now used most often on smaller farms, or where lower-value crops are being irrigated. Where crops are grown in rows or beds, surface systems can apply the water directly into the furrows, keeping it off the fruit and leaves, and thereby reducing fungal growth.

Sprinkler systems

A typical sprinkler system in Alberta consists of a pump, a pipe to bring water to the field location (the mainline or supply line), pipes to distribute the water from the mainline to the sprinklers (laterals), and the sprinkler heads themselves. In many installations, the supply pipe is buried underground. In side-roll or lateral-move sprinkler systems, the lateral pipes act as an axle for a line of large wheels, which are moved across a field using a built-in engine and

A typical on-farm pivot irrigation system



drive train. The laterals are stationery while irrigation takes place, and are then moved mechanically from set to set.

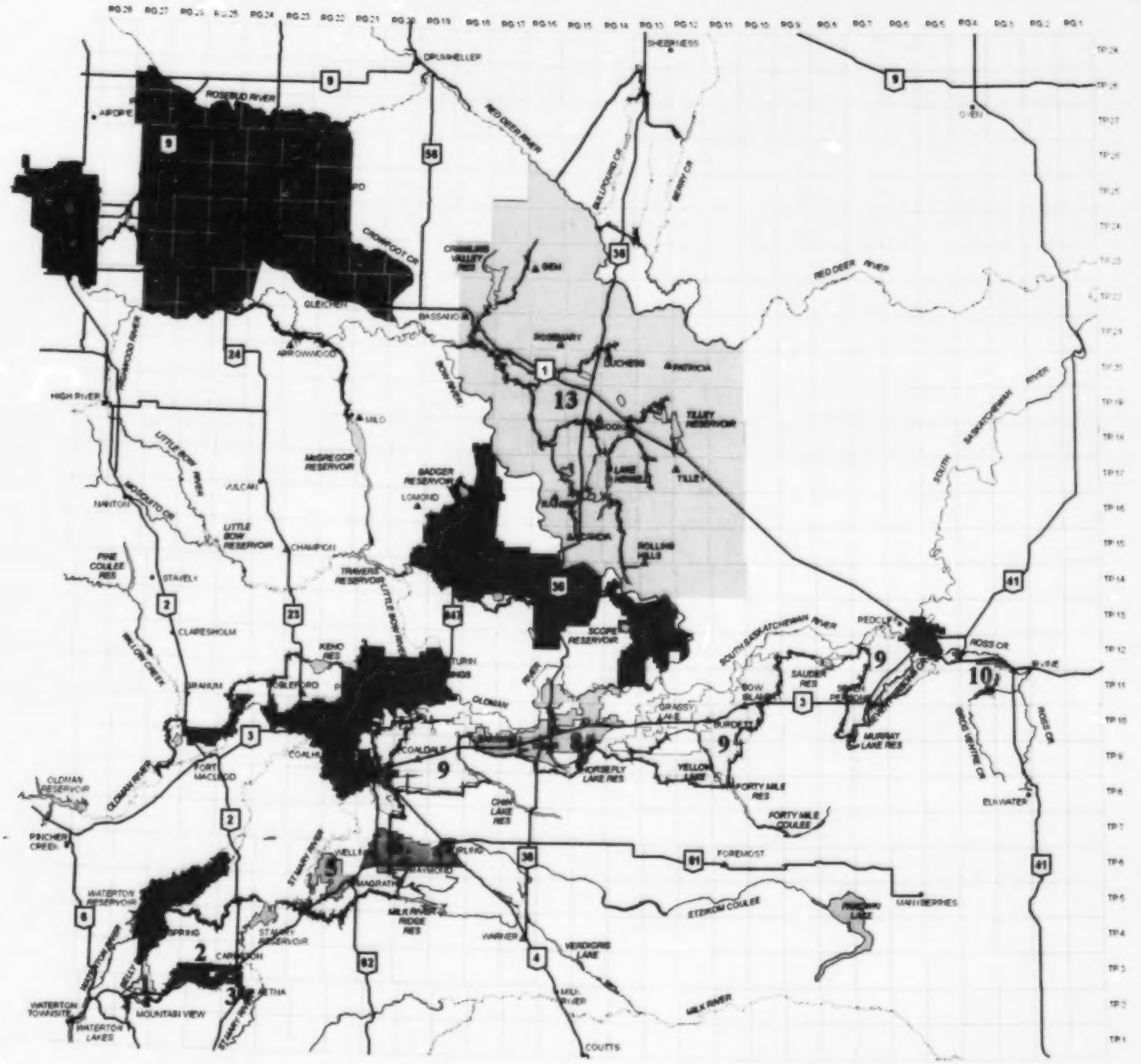
In centre-pivot sprinkler systems, the lateral is anchored to a pivot pad and rotates slowly on a swivel joint, creating a circle of irrigated crop. Centre pivots represent almost all new systems being purchased and can typically irrigate from 40 to more than 200 hectares, depending upon the lateral length. Where desired, a centre pivot system can be programmed to irrigate only a segment of a circular field. Rotation speed can also be slowed or increased to vary water application rates.

In-line pressure regulators can prevent over-watering as the topography of a field changes. For example, in low-lying areas of a field, regulators maintain constant pressure for consistent flow, compensating for the higher system pressure normally resulting from such variable terrain conditions. The systems can also be adapted with corner sections which rotate independently to more completely irrigate rectangular or odd-shaped fields. Such corner systems can increase the irrigated area under a centre pivot sprinkler by up to 15%.

Modern pumps and centre pivot systems offer considerable water and energy-saving opportunities, as well as water management flexibility to achieve optimum crop production. Pumping systems can deliver water to irrigate land at higher elevations than the canal source — land that was previously inaccessible to irrigation.

Drop tube sprinklers reduce evaporation losses by decreasing the distance between the sprinklers and the crop. They also allow for lower pressure operations that conserve energy inputs. Pump and pivot systems can be programmed to apply varying amounts of water, including fertilizers and pesticides, to different areas of a field, or to meet site-specific crop needs and soil conditions. They can also be automated to decrease labour demands.

Modern irrigation pivot with a corner system



Alberta's Irrigation Districts

Development and diversification

The economic impacts of irrigation in Alberta are substantial. Extensive areas of grassland in southern Alberta have been transformed into irrigated, highly productive farmland. In turn, this has led to the development of secondary agricultural industries.

It has been estimated that 13% of the regional gross domestic product, 19% of regional production, and 30% of regional employment opportunities in southern Alberta are directly or indirectly associated with irrigated agriculture. Almost one-third of the province's gross domestic product in processing industries is directly related to irrigation.

Irrigation brings more than water to southern Alberta. It brings people, employment and economic stability. Historically, the stable agricultural base created by irrigation has helped foster the growth of many small towns — and two large cities — which now support their own development. In the town of Raymond, for example, community irrigation projects established by Mormon pioneers at the turn of the last century made possible the growth of sugar beets and the development of a sugar refinery. The town continues to prosper through irrigated farming and ranching in the area, though the refinery has relocated to a newer, more central, and larger facility.

Statistics indicate the average population density of agricultural areas with little or no irrigation is about one quarter of that in rural locations where irrigation plays a significant role. Between 1961 and 1986, for example, population in one irrigated community of southern Alberta increased 39%. By contrast, population in a nearby town with very little irrigation decreased 18%.

Water itself is a major reason for this population growth. The irrigation infrastructure is the source of domestic and municipal water for about 50 rural communities, and hundreds of farmsteads. Without irrigation, water supplies for many southern Alberta communities would have to be trucked in.

At least 40 industries, employing more than 4,000 people, use water from southern Alberta's irrigation districts. For example, the irrigation district infrastructure provides more than $100,000 worth of water to seismic and mining operations located on and near agricultural lands. This type of spin-off industry creates additional jobs in the rural service sector and in retail operations. In turn, medical, educational, cultural, recreational and social services are more abundant in irrigated areas, because of their greater stability.

In a more direct way, irrigation benefits farmers by both significantly increasing and stabilizing crop yields. The production of sugar beets, potatoes, pulses, soft spring wheat and other specialty crops would not even be possible without irrigation. Livestock production, which has made a significant contribution to the economy of southern Alberta, has been fostered by plentiful supplies of irrigated forage, silage made from irrigated crops, irrigated feed grains, and drinking water from irrigation systems.

It should be noted, however, that irrigation is not an automatic link to farm profitability. The average irrigated farm has a greater investment in equipment and technology than a similar-size dryland farm and is thus more susceptible to decreases in market prices and inefficiencies in management. Land tends to be higher priced where irrigation is available and taxes may be higher. Increases in the price of fuel and energy affect irrigated farms more significantly, because of the greater use of powered equipment. Irrigation district members also pay from $11 to $40 per hectare per year for the water they use. Soil, topography, drainage, growing season, yield potential and markets are crucial elements in the decision-making as to whether an investment in irrigation will prove a profitable one.

Crop Diversification

Cereals and forages are the primary irrigated crops in Alberta. About 113,000 hectares of barley, 97,000 hectares of wheat and 90,000 hectares of alfalfa are grown on irrigated

major crops grown on irrigated land in alberta

M121

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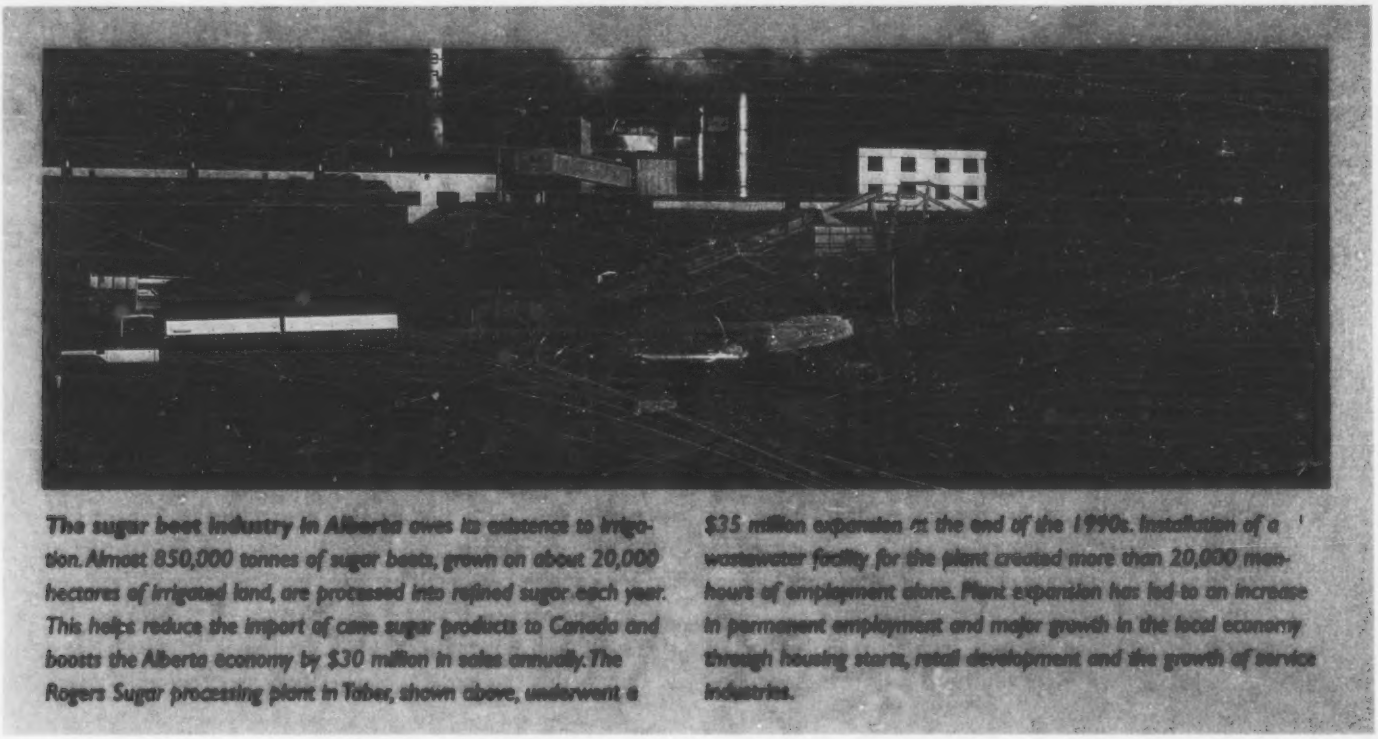

The sugar beet industry in Alberta owes its existence to irrigation. Almost 850,000 tonnes of sugar beets, grown on about 20,000 hectares of irrigated land, are processed into refined sugar each year. This helps reduce the import of cane sugar products to Canada and boosts the Alberta economy by $30 million in sales annually. The Rogers Sugar processing plant in Taber, shown above, underwent a $35 million expansion at the end of the 1990s. Installation of a wastewater facility for the plant created more than 20,000 man-hours of employment alone. Plant expansion has led to an increase in permanent employment and major growth in the local economy through housing starts, retail development and the growth of service industries.

land. The production of specialty crops and oilseeds is growing and continues to increase, especially in the Taber, Bow River, Eastern, Lethbridge Northern and St. Mary River Irrigation Districts. Irrigated crops grown include alfalfa, hard, soft and durum wheats, barley, oats, rye, field and table corn, canola, mustard, flax, potatoes, sugar beets, spices, beans, peas, lentils, carrots, wild bird seed, confectionary seeds and sod.

Irrigation not only offers the benefits of diversification to farmers, it creates opportunities in secondary manufacturing industries for society as a whole. Canola, for example, has become a major crop, processed primarily for its edible oil. Plant residues left after pressing are also made into a high-energy cattle feed. Many sawmills now use lubricants made from canola oil to grease their saw guides.

More than 3,000 hectares of beans, carrots, red beets, celery, cauliflower, berries and other fruit and vegetables grown on irrigated fields are canned or frozen in the province, at an approximate value of more than $3.5 million. Several plants process timothy and other forage crops for export. Flour products and pasta are manufactured from irrigated wheat crops. Irrigated table corn has become an important source of income, both for farmers and vegetable processors. About $1.5 million worth of irrigated corn is now canned or frozen in southern Alberta, and thousands of families enjoy the taste of freshly picked, sweet corn-on-the-cob from the Taber area each summer.

Growth has also taken place in the area's dried pea and bean fields. Bean production has grown from 275 hectares in 1973 to more than 24,000 hectares a year, with a farm-gate value of almost $25 million. It has also given rise to major processing plants in the Bow Island and Taber region. About $2 million worth of irrigated, fresh green peas are also processed in Alberta each year.

Virtually all Alberta beans are grown on irrigated land. As with other specialty crops, bean production gives Alberta farmers choices when prices in traditional commodity markets fall.

Livestock Industry

Irrigation has also led to tremendous growth in the province's livestock industry. As in other segments of agriculture, the decision on which crops to grow is being increasingly determined -by the possibility of adding value to farm products through local processing. By feeding their relatively low-value grains and forages to livestock, farmers can convert them to higher-value meat products. Irrigated barley, in particular, has been a boon to the industry, as it offers a low cost, high protein, high energy feed that produces lean, tender meat.

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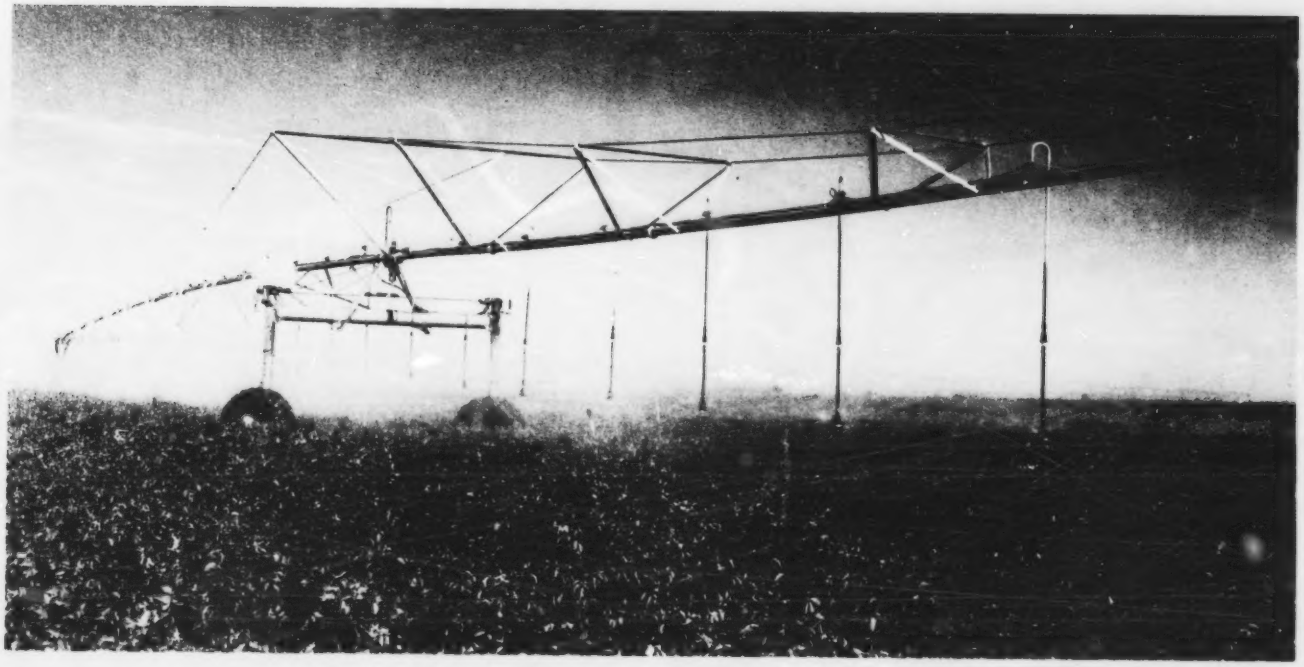


Potatoes have been grown in Alberta since the first settlers brought them to their kitchen gardens, but with the advent of large scale irrigation systems, the crop has become the focus of a major primary and secondary agricultural processing industry. In the last decade in particular, production and processing have increased enormously.

Commercial potato production was established in Alberta in the 1930s. In 1937, growers produced about 14 tonnes per hectare of table potatoes on 2400 hectares of irrigated land. Current potato production on irrigated land is more than 14,000 hectares a year, and yields have more than doubled. Approximately 65% of the crop goes to processing plants in the Taber, Lethbridge and Calgary areas. These plants produce frozen, fried and dehydrated potato products for global distribution. Lamb-Weston, McCain, Frito-Lay, Old Dutch, and Maple Leaf are the major players in the potato processing industry, employing approximately 700 people.

Irrigation water is also a critical component of potato processing plant operations. Officials at Lamb-Weston, for example, said access to a regular supply of water was a key factor in their decision to locate their first Canadian factory near Taber. The operation is capable of processing almost half a million kilograms of frozen french fries daily.

A state-of-the-art, $19 million water treatment facility at the plant supplies the facility with drinking quality water and partially treats the nutrient-rich wastewater from the processing operations. Water for the project comes from Fincastle Lake, part of the Taber Irrigation District system, and is directed through a pipeline to a collection pond at the processing plant. The water is then pumped to the treatment centre, where it is purified for use as a transport medium to carry the potatoes through the plant and wash them. The used water is then sent through other pipelines to giant holding ponds. Eventually, the wastewater is used as a liquid fertilizer, applied to local area fields.

The Lamb-Weston plant is licensed to take about 2,400 cubic decametres of water from Fincastle Lake annually. About 90% of it is returned to irrigate and fertilize nearby agricultural land. The fields where the potato wastewater is used are extensively tested to make sure they are capable of handling the extra nutrients without damage to soils or to water quality. The company has been given a coveted Alberta Emerald Award for its innovative environmental practices in the design and operation of the plant.

The McCain Foods plant at Chin, east of Lethbridge, has a tertiary treatment system for recycling their processing water. The fully purified wastewater can irrigate approximately 260 hectares of cropland. The processing plant, which employs about 250 people, uses about 5,000 hectares of potato crop annually, all from irrigated fields in southern Alberta. It is estimated this plant alone contributes about $245 million a year in direct and multiplier benefits to the provincial economy.

***Sunflower seeds** have become a major agricultural product in Alberta, thanks to irrigation and the entrepreneurial skill of Tom and Emmy Droog. The Droogs first began growing sunflowers in the early 1980s, packaging seed for bird feeders. They later ventured into producing and processing the seeds for human consumption, as a snack food. Under the Spitz brand, they sold 50,000 bags of sunflower seeds in their first year. The company now sorts, roasts, seasons and packages 75,000 bags of confectionery seeds a day, at a multi-million dollar processing plant that employs more than 60 people. The growth of the business has also given rise to a separate marketing division in Medicine Hat and a distribution network which alone employs 35 people. To obtain the sunflower seeds for this operation, the Droogs now contract with farmers in Alberta and Saskatchewan.*

Alberta's irrigation systems have helped create Canada's largest beef cattle industry by assuring the supply of relatively inexpensive pasture, feed and water. Alberta's slaughter cattle industry has been in an expansionary phase since 1988, and now accounts for almost half of the province's total farm cash income, in excess of $3 billion annually. About 40% of the country's beef herd is raised in Alberta.

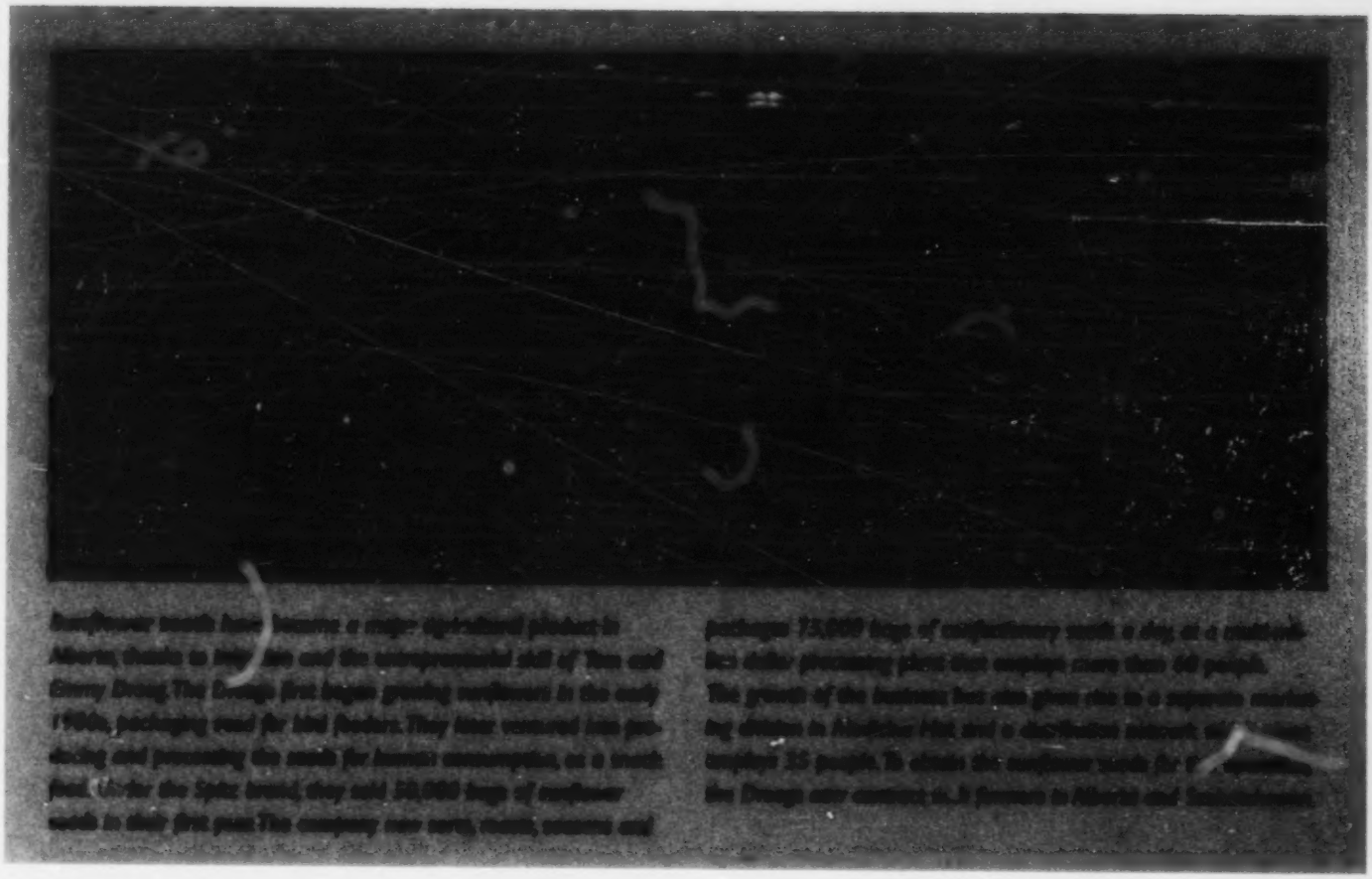
Alberta has been known for beef since settlers first came to the region and found the native grasslands and the climate good for raising range cattle. In recent years, however, the beef cattle industry has evolved into two specialized sectors, cow-calf operations and intensive feedlot operations. Feedlots allow farmers and ranchers to sell their animals throughout the year, levelling off farm income and lowering the costs of getting the cattle to market. Approximately 300 Alberta feedlots now produce almost 2.5 million slaughter cattle a year, supplying fresh beef on a year-round basis.

About 60% of the province's feeder cattle are associated with irrigated farms. In the Lethbridge area alone, more than 1.5 million beef cattle a year — about 75% of the province's total — are fed for slaughter. Estimates are that without irrigation, Alberta could lose almost one million feeder cattle sales a year to the United States.

Substantial growth has also occurred in the pork, poultry and specialty meat industries in irrigated areas. Alberta now raises and processes almost two million pigs, about half of them for sales outside the province. Bison, goats, sheep, ostriches and other livestock are fed irrigated crops or graze on irrigated pasture. About 65% of southern Alberta's dairy industry is also irrigation dependent.

Good quality livestock drinking water is crucial to a successful feedlot, ranch or dairy industry, and obtaining this water from irrigation systems is more reliable, more economical, and of higher quality than limited groundwater resources. It should also be noted that while a 10,000-head feedlot requires as much as 380,000 litres a day for the animals' drinking supplies, plus additional water for other purposes, this is still less than the water needed to irrigate 65 hectares of crop land.

However, the growth of the province's livestock industry — it's more than doubled in the last decade alone — has not been without challenges, particularly in regard to manure management. Though manure is an excellent soil conditioner and fertilizer, the expansion of the livestock industry has led to an overabundance in some regions, creating water and air



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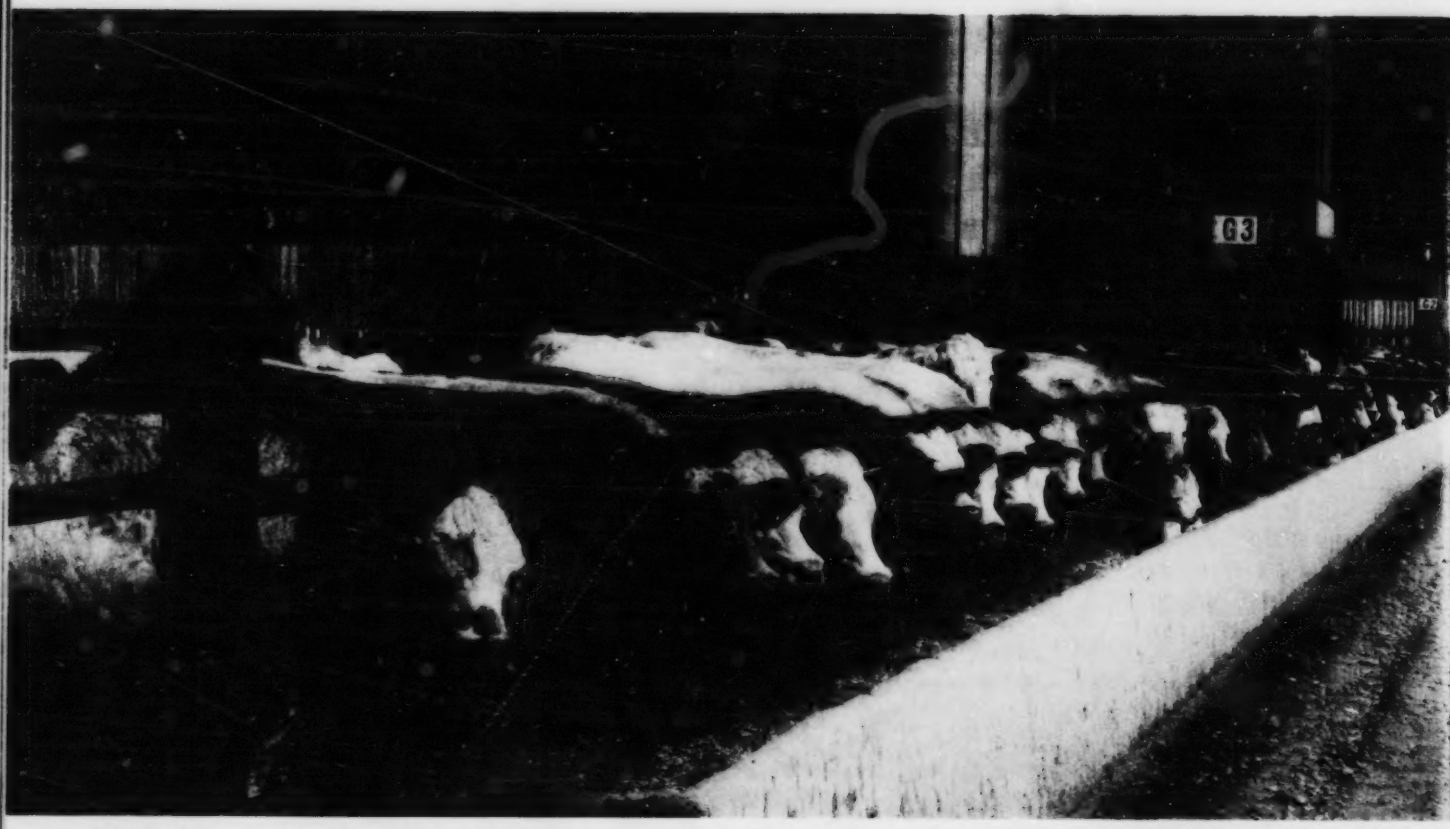


Most feedlots in southern Alberta rely on irrigation systems for an assured supply of good quality drinking water for their livestock.

quality concerns. The provincial and federal governments, in cooperation with private industry, through organizations like the Alberta Cattle Feeders Association and Alberta Pork Producers, are looking at ways of meeting these challenges.

To protect surface water quality, the industry has adopted new guidelines for land application or spreading of manure and for the proximity of livestock feeding locations to water sources. New manure lagoon designs minimize runoff and reduce odors. Research projects, conducted by government with support from the livestock industry, are exploring other ways of dealing with livestock manures. Composting can reduce the water content of the manure, to make it more economical to haul to distant fields. A method of fast-freezing feedlot effluents during the winter for use on fields later in the year shows promise, as do tests on alternative feeds that reduce the amount of manure an animal produces.

In a very direct way, irrigation also makes water available for aquaculture. Table-sized trout, tilapia and eels are being raised on about a dozen fish farms in the irrigation districts, using water from the canals for specially constructed pools. In winter months, a half-million dollar commercial fishery on southern Alberta's irrigation reservoirs gives licensees, most of them farmers, a chance to supplement their incomes with whitefish.

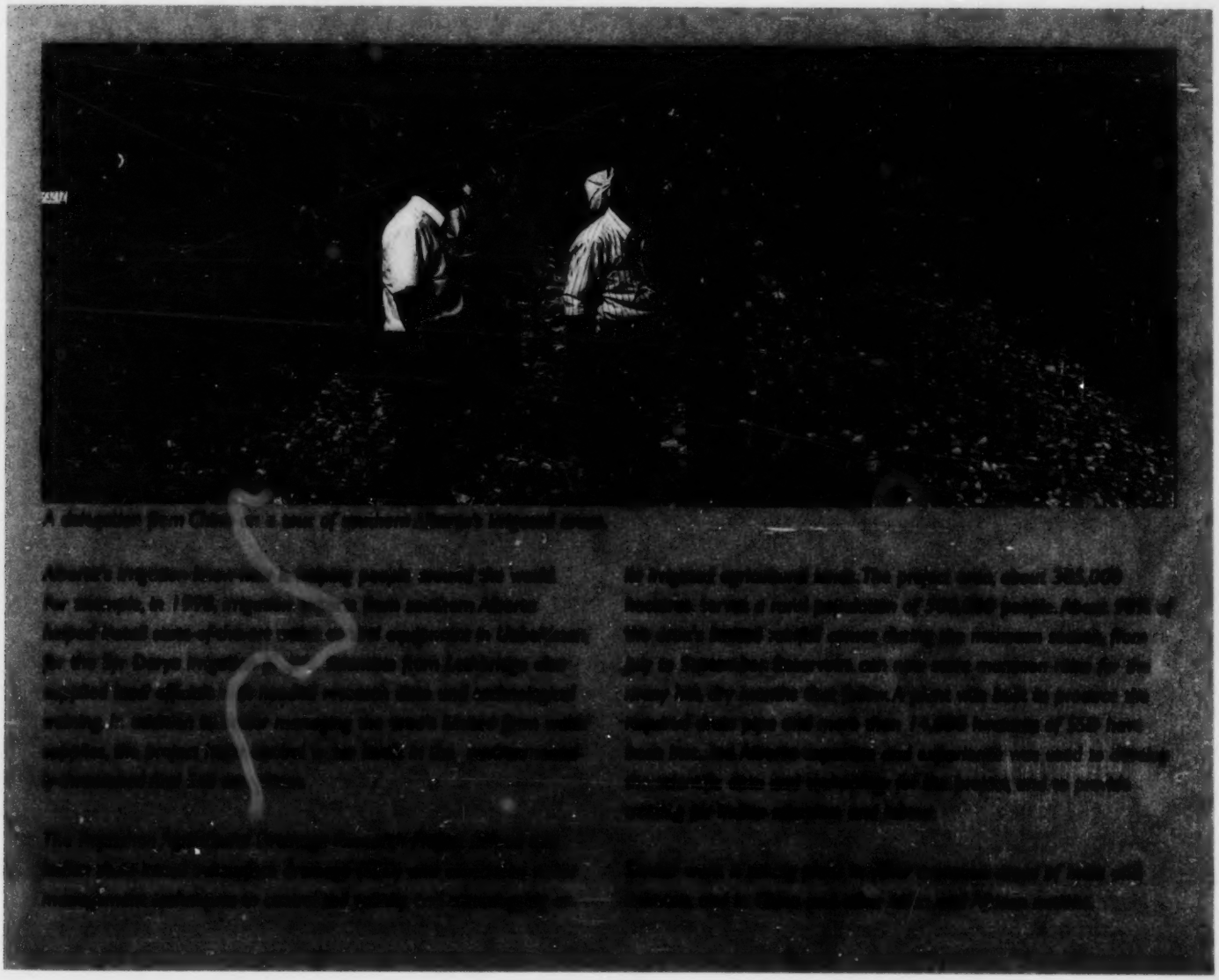
Aquaculture, or fish farming, using water from the irrigation systems has become a profitable alternative livestock venture for many southern Alberta farmers.

Feeding a Growing World

Though estimates of global population levels in the next decades vary — most experts expect the number of people in the world to double in the next 40 years — there is little doubt that more food will be needed to feed more people. Alberta's irrigated farm lands and thriving livestock industry is helping supply quality food to people, both at home and abroad, at reasonable prices.

Alberta's agricultural economy is export-oriented, with world-wide shipments of agri-food products now totalling about $5.5 billion a year. An additional $2.5 billion in agri-food products is shipped to other provinces. Wheat, meat, livestock, oilseed products, and barley are the province's chief food exports. Increasingly, however, other agricultural commodities are being grown for export. For example, more than 80% of Alberta's half-million tonne bean and pea production is sold offshore. The United States and Japan are the major buyers of our agri-food products, but sales are truly global.

Perhaps equally important as the export of food, is the export to developing countries of Alberta's scientific and technological expertise in irrigation. The gradual drying of the planet's agricultural lands threatens the livelihood of 900 million people. This global desertification also adds to soil erosion problems, further reducing the ability of people to feed themselves and sustain an agricultural economy. Well-planned and managed irrigation systems offer a partial solution.



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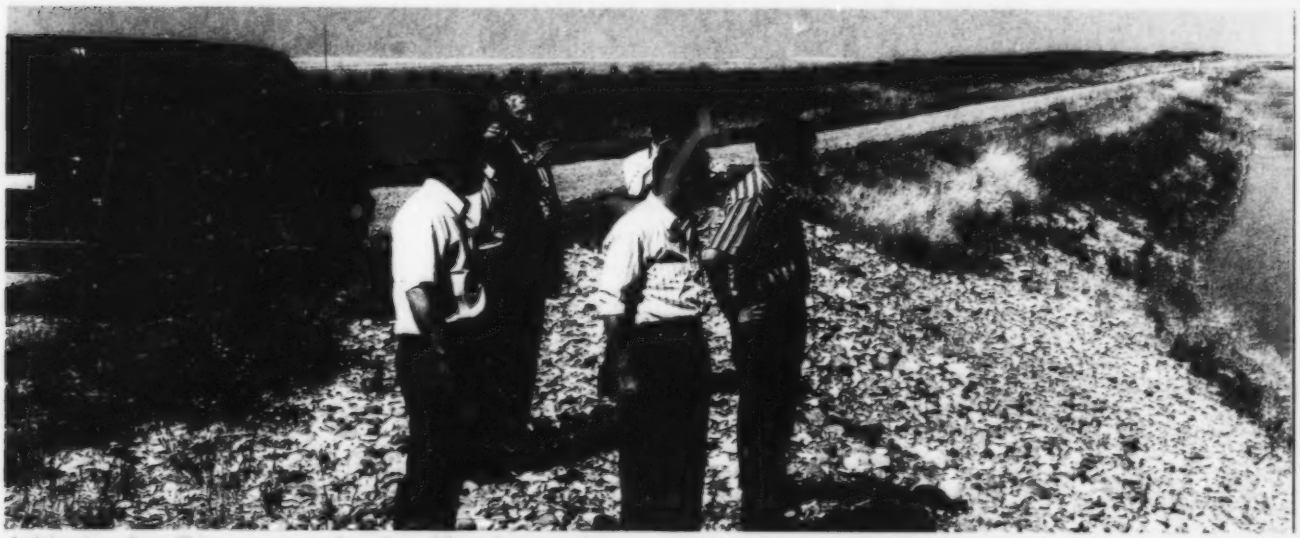
Perhaps equally important as the export of food, is the export to developing countries of Alberta's scientific and technological expertise in irrigation. The gradual drying of the planet's agricultural lands threatens the livelihood of 900 million people. This global desertification also adds to soil erosion problems, further reducing the ability of people to feed themselves and sustain an agricultural economy. Well-planned and managed irrigation systems offer a partial solution.



A delegation from China on a tour of southern Alberta's irrigated areas.

Alberta's irrigation know-how is helping people around the world. For example, in 1998, irrigation experts from southern Alberta helped install state-of-the-art water control equipment in Uzbekistan, for the Syr Darya irrigation project. Scientists from Lethbridge also supplied local officials with needed research data and technological training. In addition to better managing the area's limited farm water supplies, the project helps control water levels in the environmentally-threatened Aral Sea ecosystem.

The Rajasthan Agricultural Drainage Research Project helped this Indian state install subsurface drainage (SSD) and associated water management techniques to control soil salinity and waterlogging on its irrigated agricultural lands. The project area, about 385,000 hectares, serves a rural population of 500,000 people. About 90% of the area's limited rainfall comes during the monsoon season, from July to September. Reservoirs can now store monsoon rains for the many hot, dry months that follow. A plant was built to produce the required drain pipe and more than 14,000 hectares of SSD have been installed. Alberta expertise and experience was used to develop the scientific data and technology for the project, and to provide training for Indian scientists and labour.

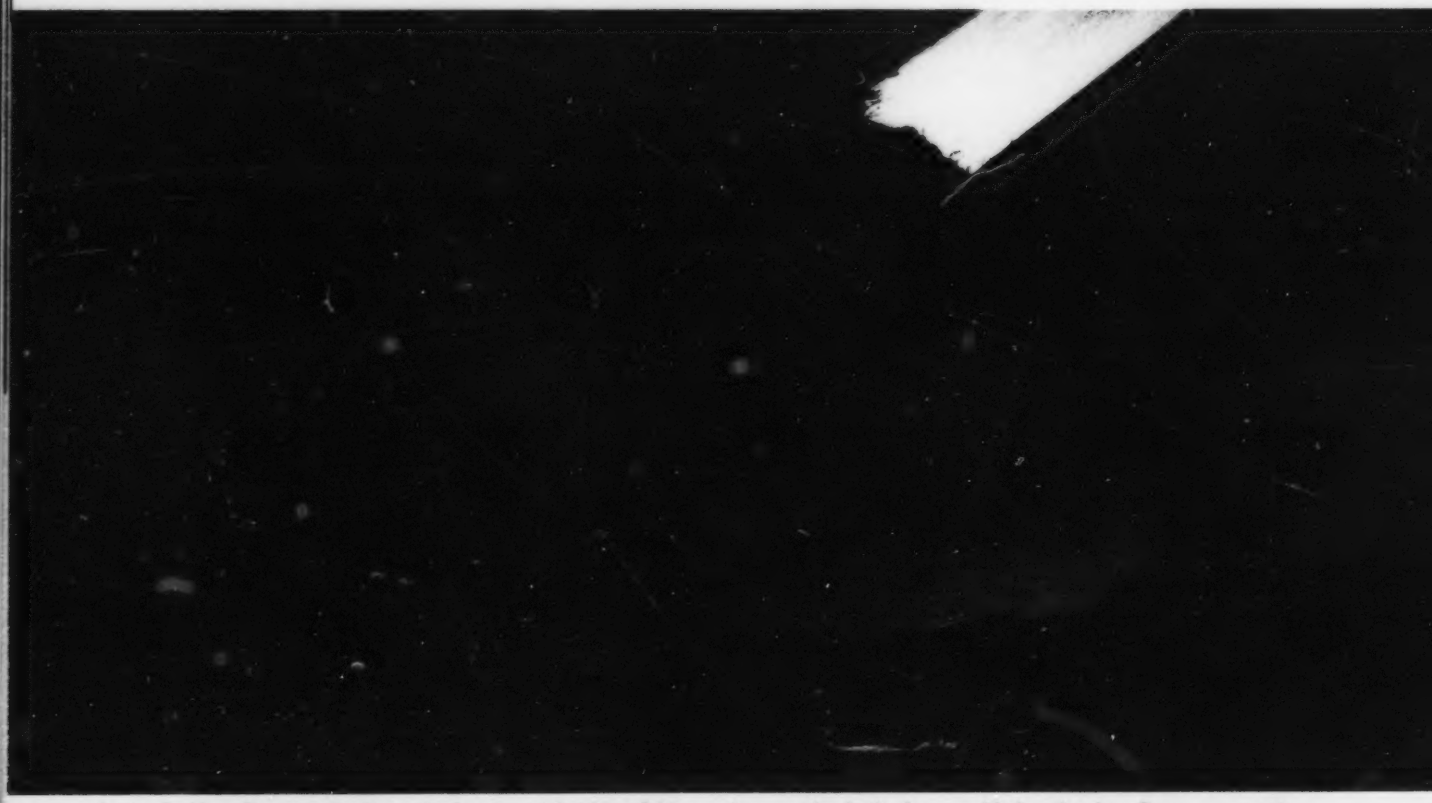
Similar work is taking place in other monsoon areas of India and Pakistan, and in China and other Asian and African nations.

Places for people, pike, and pelicans

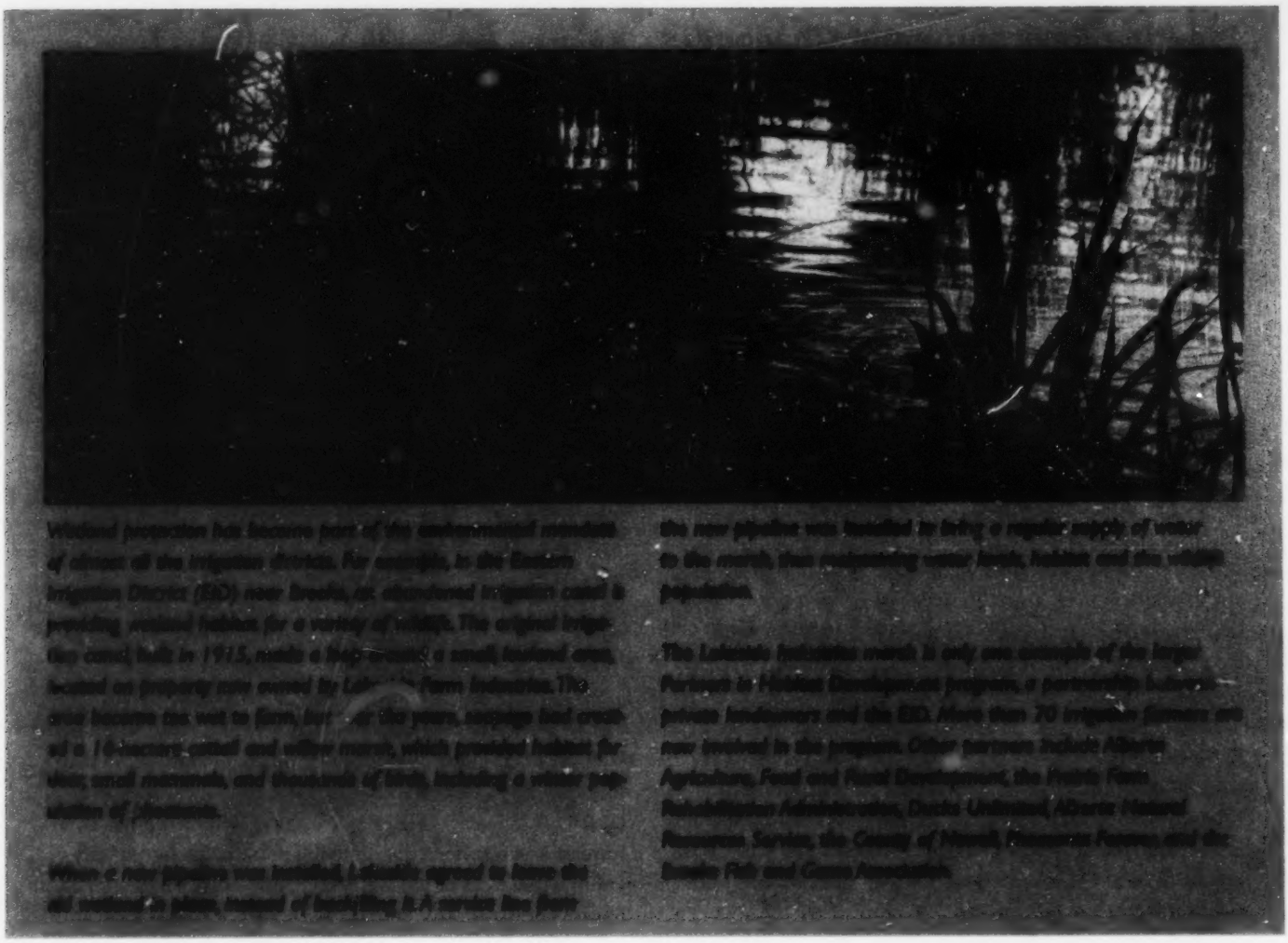
A windsurfer catches the breeze on Keho resevoir.

Alberta's irrigation systems provide water to 80 different streams, lakes and reservoirs, offering a wealth of family recreational opportunities. In the hot, dry prairie summers, residents and visitors can fish, boat, swim, windsurf, water-ski, camp and observe wildlife. In winter, irrigation reservoirs are popular for ice fishing.

The St. Mary Reservoir, a 116,000 hectare lake, supports a complete range of outdoor activities. Badger Lake, Enchant Pond, and Dead Horse Coulee in the Bow River Irrigation District are among the reservoirs known for good fishing. Kinbrook Island Provincial Park, on Lake Newell Reservoir, has excellent sailing and birdwatching. Cottage resorts have been developed on some irrigation reservoirs, and many municipalities use irrigation water for swimming pools, golf courses, parks and playgrounds. Rehabilitation programs and fish stocking have greatly enhanced the recreational potential of many irrigation sites.



At the St. Mary Resevoir, families enjoy boating, picknicking, fishing and water play, both above and below the dam. Deer, cormorants, merganzers, terns, pelicans, and swallows frequent the area and raise their young around the waterways. The dam's spillway is also home to a colony of yellow-bellied marmots.



The recreational benefits of irrigation accrue not only to people who live near reservoirs, but also to urbanites. For example, most of the 30,000 people who visit irrigation-based Park Lake each summer come from the Lethbridge area. Water levels at Chestermere Lake, a popular resort east of Calgary, are also maintained through irrigation.

In addition to the pleasure and exercise afforded by these water bodies, irrigation-based recreational activities add over $2 million a year to the economy. Multiplier effects include increased land values and a better economic and social atmosphere in rural communities.

The irrigation industry has also won the Emerald Award, the Blue Heron Award, and other citations for its environmental efforts in the last few years. About 32,000 hectares of wetlands have been created or enhanced by the irrigation industry. Such wetlands are home to both rare and common wildlife species, including burrowing owls, pelicans, ducks and geese, toads, pike, foxes and deer.

The Pine Coulee project, for example, has enhanced the sport fishery in the reservoir and created new wildlife habitat on Willow Creek. At Keenex Coulee, in the Lethbridge Northern Irrigation District, Ducks Unlimited and the LNID have restored habitat for waterfowl, shorebirds, hawks, mink and muskrat.

The Taber Irrigation District has also worked with Ducks Unlimited to enhance the waterfowl productivity of Fincastle Marsh, northwest of the hamlet of Purple Springs. Breeding populations of at least ten species of ducks, as well as geese, sharp-tailed grouse and other wildlife, have benefited from the stabilization of water levels. Bulrushes, reeds and other marsh plants provide habitat and food.

Wetland protection has become part of the environmental mandate of almost all the irrigation districts. For example, in the Eastern Irrigation District (EID) near Brooks, an abandoned irrigation canal is providing wetland habitat for a variety of wildlife. The original irrigation canal, built in 1915, made a loop around a small, lowland area, located on property now owned by Lakeside Farm Industries. The area became too wet to farm, but over the years, seepage had created a 16-hectare cattail and willow marsh, which provided habitat for deer, small mammals, and thousands of birds, including a winter population of pheasants.

When a new pipeline was installed, Lakeside agreed to leave the old wetland in place, instead of backfilling it. A service line from the new pipeline was installed to bring a regular supply of water to the marsh, thus maintaining water levels, habitat and the wildlife population.

The Lakeside Industries marsh is only one example of the larger Partners in Habitat Development program, a partnership between private landowners and the EID. More than 70 irrigation farmers are now involved in the program. Other partners include Alberta Agriculture, Food and Rural Development, the Prairie Farm Rehabilitation Administration, Ducks Unlimited, Alberta Natural Resources Service, the County of Newell, Pheasants Forever, and the Brooks Fish and Game Association.

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Meeting Environmental Challenges

Just as farmers, government and the irrigation industry are restoring and enhancing wetlands for wildlife, they are also responding to other environmental challenges, particularly with regard to water, soil and air quality.

Initiated in 1992 as a joint federal and provincial government program, the Canada-Alberta Environmentally Sustainable Agriculture (CAESA) agreement has been fundamental in driving the on-going monitoring of Alberta's water quality. The CAESA Agreement, in which Alberta Agriculture, Food an Rural Development had a pivotal role, sought to improve resource management and the growth of the agri-food industry by promoting environmentally sound practices in both primary and secondary agricultural production.

The five-year study did baseline water quality monitoring on surface waters, groundwater and farmstead water supplies, and conducted research to assess the potential for agriculture to impact water quality. The impacts of irrigated agriculture were a major focus of the study.

Different projects reviewed water quality data from more than 40 different irrigated agricultural sites in southern Alberta, conducted research on nitrate levels and herbicide concentrations in soils under irrigated fields, and studied the effects of different manure and nutrient management practices on water and soil quality.

In general, the CAESA study found that some agricultural practices were contributing to the degradation of water quality, and levels of nutrients and bacteria in surface and shallow groundwaters sometimes exceeded water quality guidelines, particularly in intensive agricultural areas.

Information gained from the study was given to the industry and the public in a comprehensive report published in 1998. The report has provided a database for the on-going monitoring and assessment of the province's lakes and streams and a starting point for projects and practices aimed at improving environmental stewardship.

The Alberta Environmentally Sustainable Agriculture (AESA) Progam was developed by the provincial government to continue the work begun under CAESA. The program is a partnership between the provincial government and industry stakeholders. It emphasizes the transfer of information and technology to farmers, ranchers and processors, and the reduction of agricultural processing inputs through more efficient use and recycling.

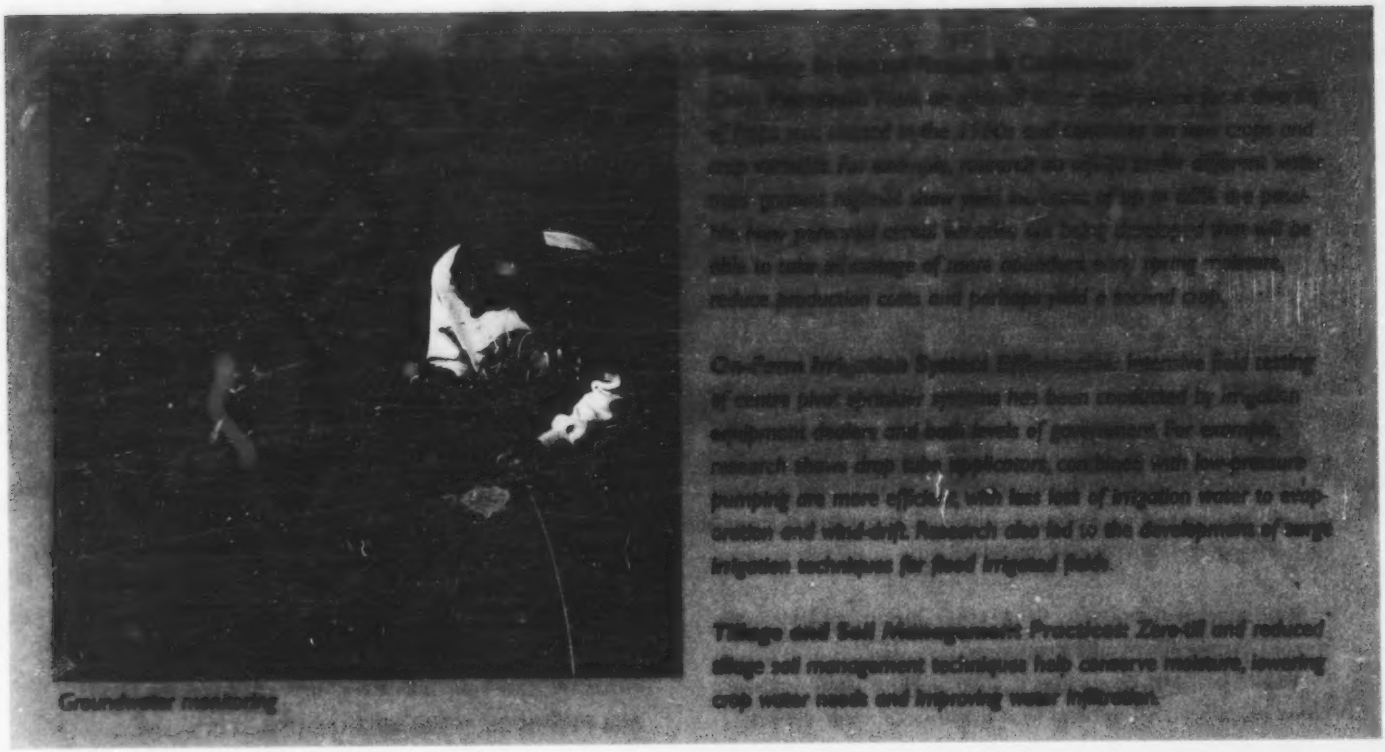
The AESA program has four main components:

- A farm-based component to encourage better management practices by farmers and ranchers involved in primary production;
- A processing-based component to promote the development and adoption of more sustainable manufacturing practices in the agricultural processing sector;
- A resource monitoring component to record and quantify changes in soil and water quality in the province, especially as affected by agriculture; and
- A research component to develop more sustainable management practices and technologies through integrated studies of water, soil, air and biodiversity.

Water quality in 23 small streams is being monitored and 41 benchmark sites have been established for on-going soil quality monitoring and assessment. The research component includes studies of how nitrates move from manured fields to streams. Of particular importance are watershed-based, integrated studies in irrigated agricultural areas in southern Alberta.

The Crowfoot Creek watershed study, for example, identified land uses that contribute to water quality deterioration in this small Bow River tributary basin in the Western Irrigation District. A grassroots, multi-stakeholder partnership has been formed, and has been instrumental in initiating better agricultural practices in the watershed, particularly in regard to improving the quality of irrigation return water to the stream. Changes include the building of a diversion to redirect runoff from a cattle-wintering site away from the creek, the construction of a fence to keep cattle from trampling the riparian areas along the creek, and redesignation of a 20-hectare field from crop to pasture land to reduce runoff in non-crop seasons.

Similar watershed-based work is being done by the Oldman River Basin Water Quality Initiative. The initiative brings together irrigation farmers and the irrigation industry, intensive livestock operators, health officials, environmental activists, and municipal, provincial and federal government agencies. The group has identified both urban and rural spractices that impact water quality and is working to understand the problems and to implement changes that will lead to improvements.



Groundwater monitoring

Breaking new ground

Just as the past 50 years have seen major improvements in irrigation farming, so there will be changes and opportunities in the future. Water allocation, environmental concerns, research on crop improvements, and the adoption of new technologies and better management practices will continue to challenge the irrigation industry in Alberta. But most experts predict the greatest changes will occur in producer's attitudes to the ways they farm and their role in the new global economy.

Alberta's goal for its agricultural industry is a $20-billion dollar value-added sector and $10 billion in primary farm production. The goal recognizes that the world has become more competitive and that changes are taking place at a faster rate, but believes the agricultural sector, particularly in irrigated areas, will continue to respond through innovation, education and farm management changes.

Many of these changes are already taking place. Farm diversification has been around a long time and many producers are finding guaranteed markets for their crops before growing them. Some producers are specifically marketing their farm's products to a more health and safety conscious public, viewing consumers' concerns about what they eat as an opportunity rather than a threat. The following paragraphs briefly describe some of the trends that can be expected to continue or accelerate, and some of the ways the irrigation industry is responding.

- Irrigated farming will become more processing oriented, with producers growing crops they can add value to on their own farms or in conjunction with other farmers.
  Small fruit growers are not only growing the berries, they're producing jams and syrups to sell under their own brand name.

- Alberta farmers will continue to find niche markets in which they can compete successfully.
  Several southern Alberta irrigation farmers are supplying restaurants and high-end grocers with organically-grown and baby vegetables.

- Producers will negotiate global sales to move higher quality traditional crops or special crops.
  Expanded Japanese markets have been found by many Alberta irrigators for high quality timothy . Pulse farmers are marketing their crops overseas, either individually or in small-grower consortia.

Groundwater monitoring

On-going Irrigation Research Challenges

Crop Research: *Work on optimal water applications for a diversity of crops was started in the 1960s and continues on new crops and crop varieties. For example, research on alfalfa under different water management regimes show yield increases of up to 60% are possible. New perennial cereal varieties are being developed that will be able to take advantage of more abundant early spring moisture, reduce production costs and perhaps yield a second crop.*

On-Farm Irrigation System Efficiencies: *Intensive field testing of centre pivot sprinkler systems has been conducted by irrigation equipment dealers and both levels of government. For example, research shows drop tube applicators, combined with low-pressure pumping are more efficient, with less loss of irrigation water to evaporation and wind-drift. Research also led to the development of surge irrigation techniques for flood irrigated fields.*

Tillage and Soil Management Practices: *Zero-till and reduced tillage soil management techniques help conserve moisture, lowering crop water needs and improving water infiltration.*

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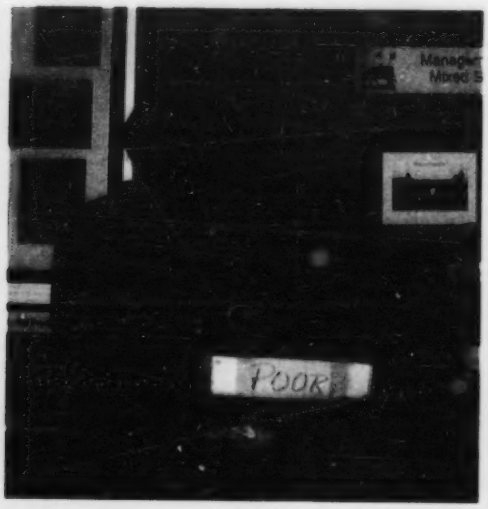

Soil sampling and farm extension programs, including field demonstrations, are some of the ways irrigation farmers and the industry are responding to the challenges of the future.

- Producers will negotiate long-term contracts with processors to supply specific crop varieties.
  Potato growers in southern Alberta plant their irrigated crops under contract to a number of local french fry and chip processing plants.

- Producers will band together to increase supplies of specialized products, thus finding more assured and more profitable markets.
  A group of southwestern Alberta organic beef producers formed a consortium to meet the quantity and quality requirements of their overseas markets. A chickpea packaging plant has been built by a group of southern Alberta farmers, so they can take better marketing advantage of the price and rotational benefits of the crop.

- Government will support the agricultural industry more than specific producers. Funding for research and development, infrastructure upgrades and education will continue, but farmer subsidies will likely decrease.
  The Alberta government funded a new chair for environmentally sustainable agriculture at the University of Alberta in 2000. The Canada-Alberta Crop Development Initiative will conduct and demonstrate field scale testing of new irrigation techniques and crop varieties.

- Education programs and training courses will become more important as changes in technology and management practices accelerate.
  About half of Alberta's farmers now attend seminars and demonstrations, or take courses on a regular basis. The Alberta government has added an agricultural program, including a course on irrigated farming, to the high school curriculum.

- Computerization, on-farm data collection and analyses, and more business-like approaches to farm management will be needed to succeed.
  About half of Alberta's irrigation farmers now use computers regularly to record and analyse seeding rates, swathing times, feed variations and other aspects of raising crops and livestock. Almost half of Alberta farmers are using computers to access the Internet and to study such things as crop marketing alternatives.

- The agricultural industry will become increasingly proactive in fostering and initiating sustainable agricultural practices.
  Alberta's irrigation districts are automating control of the canal systems to increase the water use efficiency of the system.

- Consumers and businesses will increasingly look for humanely-raised livestock and organic and environmentally-friendly products. Farm producers will meet those needs.
  Alberta grain farmers are now growing crops specifically designed for the production of ethanol as a gasoline additive and replacement. Oilseeds are being processed as lubricants and are replacing animal-derived oils in cosmetics, plastics and other consumer and industrial products.

For more information...

Organizations

Irrigation Branch, Alberta Agriculture, Food and Rural Development, (AAFRD) is the provincial agency with responsibility for irrigation. Located at the Lethbridge Research Centre, they have district offices at Strathmore, Brooks, Medicine Hat, Bow Island, and Taber. Phone: (403) 381-5140.

Agriculture and Agri-Food Canada (AAFC) conducts agricultural research to improve the competitiveness of the Canadian agricultural industry. They have several locations, including the Lethbridge Research Centre, Phone: (403) 327-4561.

Alberta Irrigation Projects Association (AIPA) represents the 13 irrigation districts. Located at 909 Lethbridge Centre Tower, 400 - 4th Avenue S., Lethbridge, Alberta T1J 4E1. Phone: (403) 328-3063.

Prairie Farm Rehabilitation Administration (PFRA), a department of Agriculture and Agri-Food Canada, promotes soil and water conservation, and good farming practices. PFRA works in partnership with the irrigation industry and other government agencies to develop the irrigation infrastructure in the three prairie provinces. In Lethbridge, at Room 203, 704 - 4 Avenue South. Phone: (403) 327-4340.

Alberta Agricultural Research Institute (AARI) is a Crown corporation established to enhance the contributions of sustainable agriculture through research and technology transfer. They conduct research on crops, livestock, policy, marketing, and resource conservation. Located at 7000 - 113 Street, Edmonton, T6H 5T6. Phone: 780-427-1956.

Internet Sites:

Roping the Web: Alberta Agriculture, Food and Rural Development's award-winning web site has up-to-date information on a variety of irrigation-related topics, as well as lots of links to other sites of interest. **www.agric.gov.ab.ca**

Aginfonet: Over 3000 agricultural websites, with an exhaustive index of Canadian government, educational and private industry sites. **www.aginfonet.com**

Publications

Water Hauler's Bulletin - Published quarterly by AAFRD, Irrigation Branch. Contains articles and news of interest to irrigation farmers and others in the industry.

MainStream - Published twice yearly by the AIPA, in the interests of responsible water management.

PFRA Communicator - Published six times yearly by the Communications Division, Regina, Sask.

Prairie Water News - Published ten times yearly by the Saskatchewan Research Council, 15 Innovation Blvd., Saskatoon, Sask. S7N 2X8

Irrigation Impact Study - Prepared by UMA Engineering for the AIPA, 1993. A seven-volume report on the activities and conditions associated with irrigation in southern Alberta.

Agroclimatic Atlas of Alberta - Alberta Agriculture, Conservation and Development Branch, 1990. Agdex 071-1.

Water Management in Alberta - Alberta Environment, 1992.

Agricultural Impacts on Water Quality in Alberta - CAESA Water Quality Report, 1998. Available from AAFRD, Edmonton, Alberta.

Irrigation in the Year 2000 and Beyond - Published by and available from the Irrigation Branch, AAFRD, at the Lethbridge Research Centre.

Irrigation Histories:

Quenching the Prairie Thirst by John Gilpin. Published by the Taber, Raymond, Magrath and St. Mary River Irrigation Districts, 2000.

Just Add Water by D. F. Gregorash. Published by the Lethbridge Northern Irrigation District, 1996.

Prairie Promises by John Gilpin. Published by the Bow River Irrigation District, 1996.

Building a Future for Southern Alberta - Alberta Public Works, Supply and Services, 1992.

History of Irrigation in Western Canada - Published by Agriculture and Agri-Food Canada, PFRA, 1982.